ON THE DIURESIS FOLLOWING ETHER NARCOSIS

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I. Introduction. — There are many references in medical literature to the influence which anesthetics exer upon the flow of urine. In the case of ether these references are almost unanimous in reporting a more or less pronounced retention of urine following anesthetization. Tait[1] reports that in operating upon a case of urinary fistula the flow of urine from the two fistular orifices entirely stopped and no urine was excreted until the patient had almost regained consciousness. The author does not mention the length of the period of anesthesia, but states that the experience was confirmed by a second trial and that he was therefore forced to operate without ether. Kemp[2] determined the influence of ether narcosis upon the rate of urine flow in dogs. He tied a small glass cannula into the ureter leading from one kidney and enclosed the other kidney in an oncometer. This investigator found an early progressive diminution in the flow of urine from the ureter and finally under long continued etherization a complete suppression of the flow was noted. Under the influence of chloroform anesthesia the renal secretion remained copious in amount and diminished only as the depression of the circulation became pronounced. The flow of urine following the administration of alcohol-chloroform-ether mixture was more copious than that observed after the induction of ether narcosis, but less in amount than the output of urine under

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the influence of chloroform anesthesia. Seelig[3] as the result of experiments upon lower animals came to the conclusion that protracted ether anesthesia caused a diminution in urine flow and that sometimes only a few drops of fluid were secreted in the course of several hours. Goll[4] came to a somewhat similar conclusion. Hawk and Gies[5] observed that after ether-chloroform anesthesia for about two hours a period of five to six hours elapsed before the first urine was voided. This primary urine retention was immediately followed, however, by a stimulation sufficient to cause the output of urine for the twenty-four-hour period following the narcosis to be considerably above normal. Fueter,[6] as the result of observations made upon clinical cases and upon dogs, claims that the urine flow was only slightly influenced and never decreased as a result of ether anesthesia, even when the anesthetic was administered for periods of two and one-half hours. Buxton[7] states that ether narcosis increases the secretions with perhaps the exception of that of the kidneys.

This paper records the data from the second of a series of observations made upon the influence of ether narcosis; the first article treating of its influence upon the excretion of nitrogen will appear in a forthcoming number of the Journal of Biological Chemistry. During the course of an investigation made at the College of Physicians and Surgeons, New York, in collaboration with Professor Gies,[8] the idea of making a thorough study of the various phases of the influence of ether anesthesia upon metabolism in general, as well as upon the hemoglobin content and the morphological constituents of the blood of well nourished and of fasting animals following such anesthesia, was suggested. A report has already been made of a few of the points in connection with our general investigation.[9]

The purpose of the experiments discussed in the present article* was to determine the diuretic influence of ether narcosis as well as to study the alterations in the body weight of the animal and the changes in the specific gravity

*These data were collected from the same general series of experiments which furnished the data for the forthcoming article upon the influence of ether anesthesia upon the excretion of nitrogen.

and the reaction of the urine as influenced by such narcosis. Anesthesia was induced for periods ranging in length from one-half hour to four and one-half hours. Each experiment was divided into three periods: a preliminary period, during which the animal was fed the proper diet to secure nitrogen equilibrium; an anesthesia period, in which ether was administered for a definite length of time (one-half hour to four and one-half hours) and its influence noted; and a final period, which served to again bring the animal into a condition of nitrogen equilibrium. Inasmuch as a series of experiments were frequently made upon the same animal, it was convenient, under such conditions, to use the final days of one experiment as the preliminary period of the next experiment. In Experiment III. anesthesia was induced for periods of one hour, two hours, and three hours respectively, on three consecutive days. This was done to determine any possible cumulative effect of the ether and of course according to the conditions of the experiment it was impossible to get the subject into nitrogen equilibrium between the one and two hour or between the two and three hour anesthesia periods.

Squibbs' ether was used as the anesthetic throughout the investigation.

II. Description of experimental plan, etc. — A series of nine experiments were conducted upon four dogs as subjects, the animals ranging in weight from 6.53 kg. to 10.18 kg. The dogs were confined in cages especially constructed for use in metabolism experiments where an accurate collection of excreta is desired.[10, 11] They were fed a suitable, accurately weighed, uniform diet (see Table I.) until nitrogen equilibrium was reached, the actual collection and analysis of excreta being preceded in each instance by several days of preliminary feeding. At the point where the data from the analyses of the food and the excreta indicated that the dog had reached a condition of nitrogen equilibrium the animal was placed under the influence of ether for a definite period. The diuretic effect of the anesthetic was then observed for a certain length of time following narcosis

and data were also collected relative to the changes in the body weight of the animal as well as in the specific gravity and reaction of the urine under these conditions.

TABLE I. *Daily diet.*

Subject.	Beef.			Cracker Dust.			Lard.			Bone Ash.			Water.
	Grams per Day.	Nitrogen.		Grams per Day.	Nitrogen.		Grams per Day.	Nitrogen.		Grams per Day.	Nitrogen.		Grams per Day.
		Per cent.	Grams per Day.		Per cent.	Grams per Day.		Per cent.	Grams per Day.		Per cent.	Grams per Day.	
Dog No. 1...	105	3.52	3.696	20	2.01	0.402	10	.022	.002	4	.02	.001	250
Dog No. 2...	120	3.52	4.224	40	2.01	0.804	15	.022	.003	5	.02	.001	300
Dog No. 3...	175	3.52	6.160	50	2.01	1.005	18	.022	.004	6	.02	.001	400
Dog No 5...	155	3.52	5.456	40	2.01	0.804	18	.022	.004	6	.02	.001	350

During the preliminary period of each experiment the urine was collected in twenty-four-hour samples, the day ending at 5 P.M. After the administration of the ether, however, the urine of the animals was collected, for periods ranging in length from twenty-four to seventy-two hours, in fractions as normally voided, and each individual fraction analyzed. In investigations such as the present study embraces, the author prefers the method of collecting the urine as normally voided by the animal [12] in preference to the custom of removing the urine by catheterization. It of course entails considerable labor to collect each individual fraction of urine voided by an animal during twenty-four to seventy-two hours following the administration of the anesthetic and to submit each of these fractions to chemical analysis, but this procedure has, however, appealed to the author as being the most satisfactory way of obtaining conclusive data regarding the influence of the narcosis. Moreover, this plan of urine collection undoubtedly tends to increase the accuracy of the deductions.

The experimental day ended at 5 P.M. and therefore all urine passed after 5 P.M. any day will be mentioned in the record as being excreted on the following day. An example is seen in Experiment VII. in which the fraction having a

volume of forty-four cubic centimeters, which is recorded as the first fraction voided on the fourth day, was passed at 7 P.M. of the third day, just two hours after the beginning of the experimental day, and further the fraction having a volume of seventy-two cubic centimeters, which is recorded as the second fraction of the fourth day, was in reality excreted on the third day, at 11.20 P.M. The determinations of the nitrogen content of foods, feces, urine, etc., were made by a modification of the Kjeldahl method which includes the preliminary digestion of the material by means of sulphuric acid and cupric sulphate.[13]

The diet of the dogs consisted of beef, cracker dust, lard, bone ash, and water, the body weight of the animal being the principal factor in determining the size of the ration at the beginning of the preliminary feeding. In some instances the ration, as calculated for an animal on the basis of the body weight, was shown by the data from the preliminary feeding tests to be inadequate to secure nitrogen equilibrium and in such instances the diet was properly modified in order to bring the subject into a suitable condition for metabolism work. Meat is, of course, the most important constituent of the dietary of a dog, and since it is of such importance great care was exercised in the preparation and preservation of the beef fed during this series of experiments. A large amount of the beef was purchased at one time, and after removing the major part of the fat and connective tissue and hashing the lean portion in a meat grinder, the juice was thoroughly expressed by means of a tincture press.[14] This juice-free meat was then very intimately mixed and after taking samples from various portions of the mass for chemical analysis, the remaining beef was wrapped in paraffine paper sheets of suitable size, pressed into the form of cakes about three-fourths of an inch in thickness, and these cakes transferred to large museum jars which were then sealed and placed in cold storage. The beef froze in a short time, but the paraffine paper prevented the cakes from freezing to each other or to the surrounding glass. The individual cakes could be easily removed, therefore, and when needed for use the desired quantity of beef

was accurately weighed and the unused portion of the cake was returned to the jar in its original paraffine paper wrapper. Beef prepared and preserved as just described was shown, by chemical analysis, to be practically unaltered in nitrogen, sulphur, and phosphorus content after having been in cold storage about four months.[15]

Throughout the investigation all urine samples were collected in twenty-four-hour periods with the exception of the twenty-four to seventy-two hours immediately after the administration of the anesthetic, during which period the individual fractions of urine were collected as voided. Powdered thymol was used as a preservative, and as a further precaution the urine samples were kept in a cool place until all analytical data had been carefully checked. The feces was removed from the cage as soon as passed and the fresh weight of the stool was then determined. The fecal mass was now carefully dried below 100° C., and after determining the weight of the dry material this was carefully powdered and an aliquot portion taken for the preparation of a composite sample. The feces for the preliminary, anesthesia, and final periods was subjected to separate chemical analysis. Every day at 5 P.M. when the dogs were fed, the hair, scurf, and feces powder were brushed from the bottom of the cage, the hair was then finely divided by means of scissors, the short pieces intimately mixed with the scurf and feces powder and the mixture subjected to analysis, after having been carefully dried at about 110° C. In experiments of this character, which are continued through long periods of time, a small amount of urine will dry upon the metal sides and bottom of the cage, together with hair, scurf, and particles of feces. These excreta must be taken into consideration in the preparation of the balance of income and outgo, and therefore it was customary in our investigation to wash the metal portions of the cages very thoroughly at the end of each experimental period and, after filtering off the solid portions (feces, hair, scurf), to make up the wash water to a definite volume and analyze it in the usual way. The material removed by filtration was added to the material brushed from the pan and manipulated as already indicated.

TABLE II.

Dog No. 1. Experiment I.

Day.	Body Weight.	Urine.						Remarks.
		Volume.	Average Volume.	Specific Gravity.	Reaction to Litmus.	Nitrogen.		
						Grams.	Total Grams.	
	kg.	*cc.*	*cc.*				*Per day.*	
1.....	6.53	220	220	1017	Acid.	3.66	3.66	
2.....	6.49	244	232	1015	Acid.	3.16	3.16	
3.....	6.45	260	241	1018	Acid.	3.97	3.97	
4.....	6.43	250	243	1019	Acid.	4.26	4.26	
Ether Anesthesia, 1 Hour.								
5.....	6.28	310	310	1017	Acid.	4.21	4.21	
6.....	6.24	100*	285	298	1020	Amphoteric.	1.09	4.54	* First urine after anesthesia, passed at 7 P.M.
		185			1020	Amphoteric.	3.45	
7.....	6.26	236		277	1017	Acid.	3.57	3.57	
8.....	6.15	310		285	1015	Acid.	4.43	4.43	
9.....	6.18	242		275	1017	Acid.	3.76	3.76	
10.....	6.18	232		269	1017	Acid.	3.58	3.58	

III. Experimental data. — 1. Discussion of Experiment I.: A brown bitch weighing 6.53 kg. served as the subject of this experiment. The preliminary period of the experiment extended over four days, during which time the daily excretion of nitrogen ranged from 3.16 grams to 4.26 grams. The nitrogen balance for the period showed an average daily loss of but .03 gram, a condition eminently satisfactory under which to begin the study of the influence of ether narcosis. Therefore on the morning of the fifth day of the experiment the animal was subjected to ether anesthesia from 9.07 o'clock to 10.07 o'clock, a period of one hour. In the preliminary anesthesia the beast struggled rather more strenuously than is generally the case. During the semi-unconscious condition following deep anesthesia the dog was observed to tremble violently, the trembling continuing for more than an hour after the beast regained complete consciousness.

By an examination of Table II. it may be seen that the average daily urine volume for the preliminary period of four days was two hundred and forty-three cubic centimeters, whereas the average daily volume for the day on which the animal was placed under ether and the following day was two hundred and ninety-eight cubic centimeters, an increase of fifty-five cubic centimeters or 22.6 per cent over the daily average for the preliminary period (see Table III., p. 211). This diuretic effect was observed on only one day (8) after this time, but the diuresis was sufficient to cause an average daily volume of two hundred and sixty-nine cubic centimeters for the entire experiment, exclusive of the preliminary period. This represents an increase of twenty-six cubic centimeters or 10.7 per cent above the daily average for the period preceding the administration of the anesthetic. Notwithstanding the fact that the ether evidently had a diuretic influence, which was indicated as has already been mentioned by an initial increase of 22.6 per cent in the urine output and an average daily increase of 10.7 per cent for the entire period thereafter, it is interesting to note that the immediate influence of the anesthetic was to cause a retention of urine, which was indicated by the fact that the first urine passed after anesthesia was not voided until the lapse of about nine hours.

The body weight of the animal was reduced from 6.43 kg. to 6.28 kg. upon the day of the anesthesia. This loss of .15 kg. cannot be considered as due entirely to the influence of the anesthetic since the animal was losing weight at the rate of .025 kg. at the time anesthesia was induced. After correcting for this normal rate of loss in body weight shown by the dog during the preliminary period we may justly consider the remaining loss of one hundred and twenty-five grams, or approximately two per cent, to have been due to the specific influence of the anesthetic. The maximum loss in body weight following anesthesia was .28 kg., which was reached on the eighth day of the experiment. Correcting for the normal loss of body weight observed in the preliminary period, the loss for the four days aggregated .18 kg. or 2.8 per cent.

TABLE III.

Influence of ether anesthesia upon urine volume.

Experiment.	Length of Anesthesia.	Length of Experiment after Anesthesia.	Average Daily Volume during Preliminary Period.	Average Daily Gain or Loss in Volume Due to the Influence of Anesthesia.		Absolute Gain or Loss in Urine Volume for the Entire Experiment following Anesthesia.	Remarks.
				Initial Gain or Loss. *	Ultimate Gain or Loss. †		
No.	*Hours.*	*Days.*	*cc.*	*cc.* *%*	*cc.* *%*	*cc.*	
I.....	1	6	243	+ 55 + 22.6 (2 days.)	+ 26 + 10.7 (6 days.)	+ 156	
II.....	2	7	237	+ 42 + 17.7 (2 days.)	+ 49 + 20.7 (7 days.)	+ 343	
III.....	6	14	279	+ 56‡ + 20.1 ‡; + 15§ + 5.4 §; + 58‖ + 20.8 ‖ (3 days.)	+ 25 + 8.9 (14 days.)	+ 350	‡ After 1 hour anesthesia. § After 2 hours anesthesia. ‖ After 3 hours anesthesia.
IV.....	½	5	298	+ 17 + 5.7 (2 days.)	+ 16 + 5.4 (5 days.)	+ 80	
V.....	1	6	458	+ 31 + 6.8 (1 day.)	− 42 − 9.1 (6 days.)	− 252	
VI.....	2	5	411	+ 53 + 12.9 (1 day.)	+ 16 + 3.9 (5 days.)	+ 80	
VII.....	4½	7	419	+ 104 + 24.8 (1 day.)	+ 13 + 3.1 (7 days.)	+ 91	
VIII.....	1	14	416	+ 87 + 20.9 (1 day.)	+ 28 + 6.7 (14 days.)	+ 392	
IX.....	1	10	385	+ 94 + 24.4 (1 day.)	+ 71 + 18.4 (10 days.)	+ 710	

* Average daily gain or loss noted during 24–48 hours after anesthesia.

† Average daily gain or loss for the entire period from the time of anesthesia until the experiment closed.

The reaction of each fraction of urine passed throughout the experiment, with the exception of the first two fractions passed after anesthesia, was acid, whereas the reaction of the two fractions mentioned was amphoteric The specific gravity of the urine during the preliminary period ranged from 1015 to 1019. During the day of anesthesia, however, the specific gravity was raised to 1020 for each fraction of urine, whereas the urine samples of the succeeding days possessed rather lower average specific gravities (1015–1017) than those of the preliminary period.

2. Discussion of Experiment II.: The subject of this experiment was the bitch which was used in Experiment I., the body weight of the animal now being 6.18 kg. She excreted an average of 3.67 grams of nitrogen daily during the preliminary period, the nitrogen balance indicating a daily loss of .05 gram. At this point the beast was again placed under the influence of ether, the narcosis continuing from 9.31 A M. to 11 31 A.M., a period of two hours or double the length of the anesthesia period of Experiment I. In this instance the violent trembling, which was so apparent the first time the animal was anesthetized, was not especially noticeable although the period of anesthesia was one hundred per cent longer.

The average daily output of urine for the preliminary days was two hundred and thirty-seven cubic centimeters or only six cubic centimeters less than the average for the preliminary period of the first experiment. This average volume, however, was increased for the day of anesthesia and the day following to two hundred and seventy-nine cubic centimeters, an increase of forty-two cubic centimeters or 17.7 per cent over the preliminary average (see Table III., p. 211). It will be remembered that this volume of two hundred and seventy-nine cubic centimeters was nineteen cubic centimeters lower than the volume excreted upon the day of anesthesia and the day following in the first experiment (two hundred and ninety-eight cubic centimeters). However, the ultimate diuretic effect was more pronounced under the influence of the two-hour anesthesia period than under the one-hour period, as was indicated by the fact that the average daily urine volume for the seven days following the preliminary period of Experiment II. was two hundred and eighty-six cubic centimeters or seven cubic centimeters per day greater than the average volume for the day of anesthesia and the following day, whereas the average daily urine volume in Experiment I. was only two hundred and sixty-nine cubic centimeters. The diuresis was therefore more persistent in Experiment II. Calculating upon the basis of two hundred and thirty-seven cubic centimeters as the normal output for this dog per day, we find that the diuretic effect of ether anesthesia induced for a period of two hours was to cause an average daily increase of forty-nine cubic centimeters or 20.7 per cent in the volume of urine excreted, whereas the total loss of water to the organism for this period aggregated three hundred and forty-three cubic centimeters. Thus the ultimate influence of the two hours of anesthesia was to cause the output of urine to assume a permanently high level, whereas the influence of the one hour of

anesthesia was to cause an increased urine volume for the day of anesthesia of approximately the same magnitude as that secured under the influence of ether narcosis for two hours, but this output was the maximum daily output for the experiment and the average daily volume gradually diminished until the experiment ended. The same delayed excretion of urine was noted in this experiment, following the anesthesia, as was observed in the first experiment. In the present instance about seven hours elapsed between the termination of the anesthetic state and the voiding of the first fraction of urine.

The body weight of the subject was constant during the preliminary period. Following the administration of the anesthetic, however, an immediate drop from 6.18 kg. to 6.06 kg., a loss of .12 kg., was registered. Thus a loss of 1.9 per cent was occasioned by the two-hour period of anesthesia. The body weight of the animal remained practically constant at the new level for the two succeeding days and then slowly sank to 5 96 kg., which level was reached on the seventh day of the experiment. The maximum effect of the anesthesia upon the body weight of the animal was therefore to cause a total loss of .22 kg. or 3.5 per cent. This loss extended through a period of five days and over fifty per cent of the loss occurred upon the day the animal was anesthetized. Comparing the influence of one hour of anesthesia with the influence of anesthesia extending through a period of two hours, we note that the former caused a total loss of body weight aggregating .18 kg. or 2.8 per cent, whereas the latter caused the somewhat larger loss of .22 kg. or 3 5 per cent.

The specific gravity of the urine for the preliminary period was 1017, whereas the specific gravity of the first fraction of urine passed after anesthesia was 1030, the normal specific gravity of 1017 being assumed for the second fraction of urine. Each of the urine fractions voided after this time for the succeeding five days of the experiment possessed a specific gravity somewhat lower (1013–1016) than that of the urine voided during the preliminary period. This is accounted for by the increased volume of urine during this period In contrasting the data from the first and second experiments we see that the two-hour period of anesthesia caused an increase from 1017 to 1030 in specific gravity in the first fraction of urine passed after the animal had regained consciousness, whereas narcosis for one hour caused an increase to 1020. In common with Experiment I. we here observe that the only urine fractions possessing other than an acid reaction are those two fractions first voided after the animal had regained consciousness, and further, as in the first experiment, these urines were amphoteric in reaction.

TABLE IV.

Dog No. 1. Experiment II.

Day.	Body Weight.	Urine.						Remarks.
		Volume.	Average Volume.	Specific Gravity.	Reaction to Litmus.	Nitrogen.		
						Grams.	Total Grams.	
	kg.	*cc.*	*cc.*				*Per day.*	
1.....	6.18	242	242	1017	Acid.	3.76	3.76	
2.....	6.18	232	237	1017	Acid.	3.58	3.58	
		Ether Anesthesia, 2 Hours.						
3.....	6.06	273	273	1014	Acid.	3.67	3.67	
4.....	6.06	*74	279	1030	Amphoteric	1.17	4.73	* First urine after anesthesia, passed at 6.30 P.M.
		134 (286)		1017	Amphoteric.	2.20		
		78		1016	Acid.	1.36		
5.....	6.05	276	278	1015	Acid.	4.03	4.03	
6.....	6.01	294	282	1015	Acid.	3.94	3.94	
7.....	5.96	312	288	1016	Acid.	4.36	4.36	
8.....	5.96	265	284	1013	Acid.	3.36	3.36	
9.....	5.98	294	286	1015	Acid.	4.18	4.18	

3. Discussion of Experiment III.: In this experiment the brown bitch which had already served as the subject in Experiments I. and II. was subjected to a third period of anesthesia. Through the influence of the previous administrations of the ether her body weight had been reduced to 5.96 kg. In the first two experiments, as we have already seen, there was but a single anesthesia period and the anesthetic was administered when the dog was in a condition of nitrogen equilibrium. In this third experiment, however, there were three periods of narcosis, *i.e.*, the animal was placed under the influence of ether at three different times on as many consecutive days, no attempt being made to secure nitrogen equilibrium between the various anesthesia periods. The plan was to get the animal into nitrogen equilibrium, then induce anesthesia for a period of one hour, this to be followed after twenty-four hours by an anesthesia period of two hours' duration and this in turn, at the end of another twenty-four hours' time, to be followed by a third application of the anesthetic through a period of three hours. It is plainly evident that in subjecting the same animal to ether narcosis for periods of varying lengths on three consecutive days, we were producing anesthesia at the second and third administrations of the anesthetic in an organism which had not yet fully recovered from the influence of the previous narcosis especially as regards the diuretic effect of the ether and the accompanying excretion of nitrogen. It was hoped, by the above procedure, that interesting data concerning the cumulative effect of the ether might be secured. The nitrogen balance for the preliminary period showed a daily loss of .10 gram. On the third day of the experiment the animal was subjected to ether anesthesia for one hour, *i.e.*, from 9.32 A.M. until 10.32 A.M., the beast being etherized with less difficulty than in either of the preceding experiments. On the fourth day of the experiment she was etherized from 10.04 A.M. to 12.04 P.M. and on the fifth day she was under the influence of the anesthetic from 9.05 A M. until 12.05 P.M. Following this last narcosis the beast slept practically the remainder of the day.

TABLE V.

Dog No. 1. Experiment III.

Day.	Body Weight.	Urine. Volume.	Urine. Average Volume.	Urine. Specific Gravity.	Urine. Reaction to Litmus.	Urine. Nitrogen. Grams.	Urine. Nitrogen. Total Grams.	Remarks.
	kg.	*cc.*	*cc.*				*Per day.*	
1.....	5.96	265	.....	1013	Acid.	3.36	3.36	
2.....	5.98	294	279	1015	Acid.	4.18	4.18	
			Ether Anesthesia, 1 Hour.					
3.....	5.83	296	335	335	1016	Acid.	4.03	4.80	
		39*			1042	Amphoteric.	0.77		* First urine after anesthesia, passed at 4.30 P.M.
			Ether Anesthesia, 2 Hours.					
4.....	5.66	84	294	315	1010	Acid.	0.34	3.75	
		23			1027	Amphoteric.	0.44		
		107			1020	Acid.	1.93		
		28†			1015	Acid.	0.29		† This urine fraction was passed while the dog was under ether.
		52‡			1026	Amphoteric.	0.75		‡ First urine after anesthesia (2 hours), passed at 4.30 P.M.

Ether Anesthesia, 3 Hours.

5.....	5.61	180 91§ 66	337	322	1023 Acid. 4.11 1028 Amphoteric. 0.74 1016 Acid. 0.56		5.41	§ First urine after anesthesia (3 hours), passed at 2 P.M.
6.....	5.68	221		297	1022	Acid. 5.05	5.05	
7.....	5.65	264		290	1017	Acid. 4.15	4.15	
8.....	5.57	266		286	1017	Acid. 4.20	4.20	
9.....	5.68	245		280	1017	Acid. 3.58	3.58	
10.....	5.65	301		283	1017	Acid. 4.08	4.08	
11.....	5.52	343		289	1016	Acid. 4.52	4.52	
12.....	5.50	372		298	1015	Acid. 4.42	4.42	
13.....	5.48	348		302	1016	Acid. 4.78	4.78	
14.....	5.45	312		303	1016	Acid. 4.19	4.19	
15.....	5.38	319		304	1017	Amphoteric. 4.63	4.63	
16.....	5.39	305		304	1017	Amphoteric. 4.52	4.52	

During the preliminary period of the experiment, as may be seen by an examination of Table V., the average daily urine volume was two hundred and seventy-nine cubic centimeters. Under the diuretic influence of the ether, however, this volume was increased to three hundred and thirty-five cubic centimeters upon the day the animal was placed under ether for one hour, this being an increase of fifty-six cubic centimeters or 20.1 per cent. Following the two-hour period of anesthesia on the next day, the volume still remained high (two hundred and ninety-four cubic centimeters) and reached a maximum of three hundred and thirty-seven cubic centimeters upon the fifth day of the experiment when the animal was placed under ether for a period of three hours; the increase for this day was fifty-eight cubic centimeters or 20.8 per cent. The combined effect of the six hours of anesthesia distributed, as noted, through three consecutive days was therefore to cause a diuresis represented by the increased excretion of one hundred and twenty-nine cubic centimeters of urine during the three-day period. This represented an average daily increase of forty-three cubic centimeters or 15.4 per cent. An examination of Table V. will show the interesting fact that the diuresis of the days of anesthesia was exactly compensated during the next four days. The data there tabulated show that the average daily urine volume for those four days was only two hundred and forty-nine cubic centimeters, and further that the average daily output of urine for the seven days after the preliminary period was two hundred and eighty cubic centimeters, or but one cubic centimeter in excess of the average daily volume for the preliminary period. It is therefore evident that the diuretic effect of the six hours of anesthesia caused a considerable immediate increase in the volume of urine eliminated, but that this influence was entirely counterbalanced by the uniformly low average daily output of urine for the succeeding four days. An examination of the data for this experiment reveals the further interesting fact that there was apparently a second well-marked diuresis which began on the tenth day of the experiment (the fifth day after the final administration of the anesthetic) and increased for a period of three days, yielding the maximum excretion for Experiments I., II., and III. (three hundred and seventy-two cubic centimeters) upon the twelfth day of the experiment. From this point the average daily volume sank fairly regularly until the close of the experiment. This diuresis which culminated upon the twelfth day of the experiment with an output of three hundred and seventy-two cubic centimeters for that day caused an average daily output of three hundred and thirty-nine cubic centimeters of urine per day for a period of three days. It was therefore a more pronounced diuresis than that which occurred coincidently with the anesthesia periods, inasmuch as the immediate diuretic influence of the six hours anesthesia was represented by an increase of 15.4 per cent in the average daily urine volume, whereas this recurrent diuresis of days ten to twelve represented an average daily increase of 21.5 per cent. As has been noted, the diuresis continued with slightly lessened force until the end of the experiment, its aggregate effect being represented by an increase of

three hundred and fifty cubic centimeters in the volume of urine excreted, all of which excess may be considered to have been excreted under the influence of the secondary diuresis which began on the tenth day of the experiment, since the average daily volume of urine for the first seven days after anesthesia was practically the same as the average daily volume for the preliminary period.

During the preliminary period the body weight of the animal showed a tendency to increase somewhat (.02 kg. per day). Upon the administration of the ether for a period of one hour, however, the body weight immediately dropped from 5.98 kg. to 5.83 kg., a decrease of .15 kg. or 2.5 per cent. The following day under the influence of anesthesia for a period of two hours, the body weight of the beast suffered a further decrease to 5.66 kg., a decrease of .17 kg. or 2.9 per cent from the weight as observed the previous day and a total loss of .32 kg. or 5.3 per cent calculated upon the basis of the weight of the dog upon the day preceding the first anesthesia. Since it is evident from all our experiments that anesthesia causes a loss of body weight, one would naturally expect the loss to be fully as great after an anesthesia period of three hours' duration as after one which continued for one hour or two hours. However, an examination of the data in Table V. will show that such was not the case in the experiment under consideration. The body weight of the animal before the three-hour anesthesia period was 5.66 kg. and decreased to 5.61 kg. under the influence of the anesthetic. Thus the loss in body weight in this case was but .05 kg. or .9 per cent, a loss which was the minimum loss produced by ether narcosis in any of the experiments here reported. This emphasizes the possibility that there is a more or less definite limit for the immediate loss in body weight which may be brought about by the administration of the anesthetic and renders it extremely probable that that limit was nearly reached as the effect of the first and second periods of narcosis. Therefore when the animal was subjected to the three-hour period of anesthesia the loss was less than it had been in either of the other cases. The total loss of body weight for the three days upon which ether was administered was .37 kg. or 6.2 per cent of the weight during the preliminary period. There was a tendency for the body to make good the loss in weight during the two days following the narcosis, the weights for these days being 5 68 kg. and 5.65 kg. respectively. This effort was apparently of no avail however, for loss of weight continued in a fairly regular manner until the close of the experiment, the weight for the final day being 5.39 kg. The total loss in body weight for the fourteen days after anesthesia was .59 kg. or 9.8 per cent. Correcting for the normal daily gain in body weight observed during the preliminary period, the losses in body weight registered during the experiment were as follows: Loss occasioned by one-hour anesthesia, .17 kg. or 2.8 per cent, two-hours anesthesia, .19 kg. or 3.2 per cent, three-hours anesthesia, .07 kg. or 1.2 per cent. The total loss for the three days was .39 kg. or 6.5 per cent and for the entire fourteen days aggregated .61 kg. or 10.2 per cent.

The specific gravity of the urine first passed after anesthesia was much higher than the specific gravity of the urine of the normal period. In this instance the specific gravity of the thirty-nine cubic centimeter fraction of urine, passed about six hours after a one-hour period of anesthesia, was 1042. This was the maximum specific gravity for the entire series of experiments. In this connection it is very noteworthy that the second urine fraction, voided after the one-hour period of anesthesia, possessed the minimum specific gravity for the entire series of experiments. The passage of two fractions of urine of such divergent densities so near together was an extremely interesting phenomenon and illustrates very strikingly the value of collecting the individual urine fractions as voided. The decided drop in the gravity from 1042 to 1010 is easily explained in this connection, however. The former fraction was passed at 4.30 P.M., just thirty minutes before the end of the experimental day. At 5 P.M. the animal was fed the usual ration, including two hundred and fifty cubic centimeters of water, and two hours later, at 7.30 P.M., she voided the fraction of urine having the low specific gravity. The data concerning these two specific gravities also serve to substantiate the belief that in collecting the urine in fractions as voided we can generally be fairly certain that the bladder is quite thoroughly emptied at the passage of each fraction. Referring to the point in mind, it is more or less certain that, had any considerable portion of the urine fraction having a specific gravity of 1042 been retained in the bladder and voided with the succeeding fraction, the specific gravity of this latter fraction would certainly have been higher than 1010. Following this latter urine fraction one was voided an hour later possessing a specific gravity of 1027. The first fraction voided after the two-hour anesthesia period had a specific gravity of 1026, whereas the initial urinary excretion following the three-hour period of narcosis possessed the slightly higher specific gravity of 1028. From this point on to the end of the experiment the specific gravity of the various samples of urine ranged, for the most part, from 1015 to 1017 inclusive.

The urine of the preliminary period possessed the normal acidity. This acid reaction was replaced in the first urine fraction voided after anesthesia for one hour, by an amphoteric reaction. All urine passed from this time until after the two-hour anesthesia period was acid in reaction, with the exception of the third fraction passed after one hour's narcosis, which possessed an amphoteric reaction. Why this amphoteric reaction should recur at this point is not apparent. From this time until the first urine after the two-hour period of anesthesia was voided the samples were acid in reaction and at that time the usual amphoteric reaction recurred. The amphoteric reaction was also possessed by the urine fraction first voided after the three-hour anesthesia period. All samples of urine from this point to two days before the end of the experiment were of normal acidity and at that time the amphoteric reaction again recurred, for no apparent reason.

4. Discussion of Experiment IV.: A spotted bitch weighing 7.72 kg. was used as subject in this experiment. She excreted an average of 4.65 grams of nitrogen per day during the preliminary period, the balance for the income and outgo of nitrogen showing an average daily loss of .07 gram. Upon the fourth day of the experiment proper the beast was subjected to ether narcosis for a period of one-half hour, *i.e.*, from 8.15 A.M. to 8.45 A.M. She made a rapid recovery from the effect of the anesthetic and twenty-five minutes after the close of the narcosis, *i.e.*, at 9.10 A.M., she was apparently entirely free from any influence of the ether and as bright and active as usual. This recovery was in very marked contrast to that shown by the brown bitch in the first experiment.

The data in Table VI. indicate that the average urine volume for the preliminary period was two hundred and ninety-eight cubic centimeters. Contrary to the conditions obtaining in Experiments I., II., and III., the urine volume for the day upon which ether was administered was only two hundred and seventy cubic centimeters, or twenty-eight cubic centimeters less than the average daily output of the preliminary period. The next day, *i.e.*, the day after anesthesia, the volume of urine was three hundred and sixty cubic centimeters, this being sixty-two cubic centimeters or 20.8 per cent above the daily average for the preliminary period. The volume continued high for the next two days, registering three hundred and ten cubic centimeters and three hundred and forty-four cubic centimeters respectively. On the final day of the experiment the daily volume sank slightly below normal (two hundred and eighty-five cubic centimeters). Taking into consideration the whole of the experiment after anesthesia, with the exception of the final day, we observe that the average daily urine volume was three hundred and twenty-one cubic centimeters, a daily increase of twenty-three cubic centimeters or 7.7 per cent above the normal. Ether narcosis for a period of one-half hour, therefore, caused an increase in the excretion of urine during the next four days of ninety-two cubic centimeters or 7.7 per cent.

For a period of several days during the preliminary period the bitch lost an average of .03 kg. per day, the weight of the animal being 7.66 kg. at the time she was placed under the influence of ether for a period of one-half hour. The effect of the anesthesia was to cause the body weight to drop from 7.66 kg. to 7.44 kg., a decrease of .22 kg. or 2.8 per cent. Correcting for the .03 kg. loss registered daily during the preliminary period, the loss on this day was .19 kg. or 2.5 per cent. On the next day there was a slight increase in weight notwithstanding the fact that the urine volume was the maximum for the experiment. From this point to the end of the experiment the dog gradually lost weight, the final weighing showing a body weight of 7.35 kg. Making the correction for the normal daily loss observed during the preliminary period, we observe that the one-half hour of ether anesthesia caused a loss of body weight during the succeeding five days aggregating .16 kg. or 2.1 per cent.

TABLE VI.

Dog No. 2. Experiment IV.

Day.	Body Weight.	Urine. Volume.	Urine. Average Volume.	Urine. Specific Gravity.	Urine. Reaction to Litmus.	Urine. Nitrogen. Grams.	Urine. Nitrogen. Total Grams.	Remarks.
	kg.	*cc.*	*cc.*				*Per day.*	
1.....	7.72	270	270	1019	Acid.	4.49	4.49	
2.....	7.69	310	290	1017	Acid.	4.50	4.50	
3.....	7.66	315	298	1018	Acid.	4.95	4.95	
			Ether Anesthesia, ½ Hour.					
4.....	7.44	230 } 270 40* }	270	1020 1038	Acid. Acid.	3.87 1.10	} 4.97	* First urine after anesthesia, passed at 4.30 P.M.
5.....	7.46	314 } 360 46 }	315	1015 1026	Acid. Acid.	4.05 0.89	} 4.94	
6.....	7.42	60 } 310 250 }	313	1015 1017	Acid. Acid.	0.49 3.34	} 3.83	
7.....	7.36	344	321	1017	Acid.	5.02	5.02	
8.....	7.35	285	314	1016	Acid.	4.14	4.14	

The specific gravity of the urine passed during the preliminary period varied from 1017 to 1019. The specific gravity of the urine fraction first passed after anesthesia, possessed a specific gravity of 1038, which was next to the highest specific gravity noted up to this time. The next fraction was of low specific gravity (1015), but on the following day at approximately the same hour on which the urine having the specific gravity of 1038 was passed, the dog voided a second fraction of about the same volume which had a specific gravity of 1026. All the fractions passed during the remainder of the experiment ranged from 1015 to 1017. For the first time, there was no change in the reaction of the urine under the influence of the narcosis, the reaction remaining acid throughout the experiment.

5. Discussion of Experiment V.: A dog weighing 10.18 kg. served as the subject of this experiment. The nitrogen balance for the preliminary period showed a daily gain of .09 gram. Narcosis was induced upon the fourth day of the experiment from 9 15 A.M. to 10.15 A.M. A feature of the preliminary anesthesia was the violent struggling and the profuse salivation of the animal. Upon being returned to his cage after the anesthetization it was 11.15 A.M. before he could stand.

During the preliminary period the dog voided an average of four hundred and fifty-eight cubic centimeters of urine per day as may be seen from an examination of Table VII. Upon the day the ether was administered the diuretic influence was sufficient to raise this volume to four hundred and eighty-nine cubic centimeters, an increase of thirty-one cubic centimeters or 6.8 per cent for the day. Contrary to the condition seen to obtain in previous experiments, the diuretic influence ceased at this point and the remaining days of the experiment each showed a subnormal urinary volume. Therefore, when we compute upon the basis of the six days following the one-hour period of anesthesia, we find that the ultimate influence of the ether upon the flow of urine was to cause a decrease of two hundred and fifty-two cubic centimeters or 9.1 per cent for the entire period.

The body weight of the animal at the time of the administration of the ether was 10.04 kg. and was falling approximately at the rate of .04 kg. per day. The one hour of anesthesia caused a further decrease in body weight to 9.86 kg., which represents an actual loss of .18 kg. Correcting for the normal daily loss at the time the anesthetic was administered it is found that the loss in weight actually due to the effect of the ether was .14 kg. or 1.4 per cent. The loss in body weight was also well marked upon the next day after narcosis, the actual loss for the two days due to the influence of the anesthesia being .19 kg. or 1.8 per cent. From this point through to the end of the final period of the experiment the animal suffered a gradual, although very slight, daily loss in body weight. The weight upon the last day of the experiment was 9.70 kg., the animal having lost one per cent in body weight during the experiment.

TABLE VII.

Dog No. 3. Experiment V.

Day.	Body Weight.	Urine. Volume.	Urine. Average Volume.	Urine. Specific Gravity.	Urine. Reaction to Litmus.	Urine. Nitrogen. Grams.	Urine. Nitrogen. Total Grams.	Remarks.
	kg.	*cc.*	*cc.*				*Per day.*	
1.....	10.18	460	...	1017	Acid.	6.50	6.50	
2.....	10.08	450	455	1015	Acid.	6.29	6.29	
3.....	10.04	465	458	1017	Acid.	6.87	6.87	
		Ether Anesthesia, 1 Hour.						
4.....	9.86	395	489	489	1018	Acid.	5.93	7.11	*First urine after anesthesia, passed at 11.30 A.M.
		36*			1030	Acid.	0.26		
		58			1034	Acid.	0.92		
5.....	9.77	300	370	429	1021	Acid.	5.20	6.10	
		70			1016	Acid.	0.90		
6.....	9.73	120	405	421	1015	Acid.	1.23	5.53	
		285			1017	Acid.	4.30		
7.....	9.73	408		418	1017	Acid.	6.04	6.04	
8.....	9.71	392		413	1018	Acid.	6.52	6.52	
9.....	9.70	430		416	1017	Acid.	6.42	6.42	

The specific gravity data show the customary features, which consist principally of a high specific gravity for the fractions of urine first voided after anesthesia. In this instance the first urine fraction after narcosis possessed a specific gravity of 1030 and the second fraction possessed the slightly higher specific gravity of 1034. From this point the specific gravities were approximately the same for the remainder of the experiment as those noted for the urine passed during the preliminary period. In common with the data from Experiment IV. the data for the reaction of the urines of this experiment show them to have been uniformly acid.

6. Discussion of Experiment VI. : The dog which served as subject in Experiment V. was likewise used in this experiment, the body weight of the animal having fallen from 10.18 kg. to 9.70 kg. in the interim. The daily gain of .18 gram of nitrogen shown by the nitrogen balance for the preliminary period constituted the poorest balance obtained in a preliminary period at any time during our investigation. At this point the beast was placed under the influence of ether narcosis from 9.05 A M. until 11.05 A.M., *i.e.*, for a period of two hours. Nothing out of the ordinary occurred in connection with the administration of the anesthetic or the subsequent recovery from its influence. During the recovery the dog tumbled somewhat violently about the cage, but was unable to stand for about twenty minutes.

As is indicated in Table VIII., the average urine volume for the preliminary period of two days was four hundred and eleven cubic centimeters. The diuretic effect of the ether was exhibited at once causing a volume of four hundred and sixty-four cubic centimeters of urine to be voided during the day the ether was administered. This volume represented an increase of fifty-three cubic centimeters or 12.9 per cent over the normal excretion. During the next four days the urine volumes were alternately decreased and increased from the normal. Taking the entire period after anesthesia into consideration it is seen that the average daily volume was four hundred and twenty-seven cubic centimeters, an average daily increase of sixteen cubic centimeters or 3.9 per cent.

TABLE VIII.

Dog No. 3. Experiment VI.

Day.	Body Weight.	Urine. Volume.	Urine. Average Volume.	Urine. Specific Gravity.	Urine. Reaction to Litmus.	Urine. Nitrogen. Grams.	Urine. Nitrogen. Total Grams.	Remarks.
	kg.	*cc.*	*cc.*				*Per day.*	
1.....	9.71	392	....	1018	Acid.	6.52	6.52	
2.....	9.70	430	411	1017	Acid.	6.42	6.42	
				Ether Anesthesia, 2 Hours.				
3....	9.46	375	464	1017	Acid.	6.06	7.32	
		6*		1030	Acid.	0.04		* Fraction passed at 11.20 A.M., 15 minutes after end of anesthesia.
		14†		1031	Acid.	0.22		† Passed at 12.30 P.M.
		30		1033	Amphoteric.‡	0.47		‡ Alkaline reaction predominating.
		39		1039	Amphoteric.§	0.53		§ Alkaline reaction predominating.
4.....	9.56	340	402	1020	Acid.	6.65	6.65	
5.....	9.52	494	433	1014	Acid.	6.24	6.24	
6.....	9.53	386	421	1019	Acid.	6.45	6.45	
7.....	9.51	452	427	1018	Acid.	6.84	6.84	

At the time the dog was placed under ether the body weight of the animal was 9.70 kg. As usual the effect of the ether was to cause a loss of body weight, the exact loss in this instance, after correcting for the normal rate of loss as manifested during the preliminary period, being .23 kg. The two hours of anesthesia was therefore instrumental in causing a 2.3 per cent loss in body weight. Upon the day after anesthesia was induced we observe the unique phenomenon of a pronounced increase in body weight, and further, during each day of the remaining period the body weight was on a higher level than during the day of anesthesia. Throughout the entire series of experiments this was the only instance of an increase of weight after the anesthesia period. There was, of course, no increase in weight above that possessed by the animal before he was subjected to the influence of the anesthesia, the increase being computed upon the weight as determined at the end of the first day of anesthesia. The weight of the animal on the final day of the experiment was 9.51 kg., which represents a loss of 1.9 per cent in body weight after anesthesia.

As usual the fractions of urine first passed after the anesthesia period were of high specific gravity. In this instance, instead of finding the maximum specific gravity in connection with the urine fraction first voided after anesthesia we observe that the specific gravity of that fraction was 1030 and that there was a gradual, progressive increase in the specific gravity of the next three samples. These fractions possessed specific gravities of 1031, 1033, and 1037 respectively. The usual specific gravities obtain after the passage of these fractions until the end of the experiment. The reaction of the urine changed from acid to amphoteric under the influence of the anesthesia, but contrary to the general custom the amphoteric reaction did not accompany the first fraction after narcosis but was noted in connection with the third and fourth fractions only.

7. Discussion of Experiment VII.: Ether narcosis was induced, in this instance, upon the animal which had previously served as subject in Experiment VI., the body weight of the beast having been reduced under the influence of that experiment from 9.70 kg. to 9.51 kg. The data for the excretion of nitrogen during the preliminary period showed a daily loss of .04 gram at the time anesthesia was induced. Ether was administered on the morning of the third day of the experiment, the period of anesthesia extending from 8.58 A.M. until 1.28 P.M., *i.e.*, for a period of four and one-half hours. Shortly after the commencement of anesthesia the dog ceased breathing, but artificial respiration was successfully employed and the subsequent anesthesia was uneventful. A stuporous inactive condition followed the narcosis and remained in evidence throughout the entire day, the beast apparently sleeping a portion of the time. His food was eaten with his customary eagerness at feeding time, nevertheless.

TABLE IX.

Dog No. 3. Experiment VII.

Day.	Body Weight.	Urine. Volume.	Average Volume.	Specific Gravity.	Reaction to Litmus.	Nitrogen. Grams.	Nitrogen. Total Grams.	Remarks.
	kg.	*cc.*	*cc.*				*Per day.*	
1.....	9.53	386	.....	1019	Acid.	6.45	6.45	
2.....	9.51	452	419	1018	Acid.	6.84	6.84	
		Ether Anesthesia, 4½ Hours.						
3.....	9.29	364	523	523	1015	Acid.	4.82	6.63	* Passed during preliminary anesthesia. † First urine after anesthesia, passed at 2.15 P.M. ‡ Alkaline reaction predominating. § Alkaline reaction predominating. ‖ Alkaline reaction predominating. ¶ Alkaline reaction predominating.
		18*			1024	Acid.	0.40		
		106†			1037	Acid.	0.96		
		21			1018	Amphoteric‡	0.23		
		14			1036	Amphoteric§	0.22		
4.....	9.36	44	361	442	1032	Amphoteric‖	0.54	7.69	
		72			1039	Amphoteric¶	2.68		
		151			1018	Acid.	2.72		
		58			1015	Acid.	0.90		
		36			1024	Acid.	0.85		
5.....	9.37	462		449	1017	Acid.	6.37	6.37	
6.....	9.31	430		444	1017	Acid.	5.54	5.54	
7.....	9.30	420		439	1018	Acid.	6.02	6.02	
8.....	9.27	397		432	1019	Acid.	6.86	6.86	
9.....	9.23	430		432	1017	Acid.	6.54	6.54	

An examination of the data for the urine volume as given in Table IX. shows the average daily urine output for the preliminary period to have been four hundred and nineteen cubic centimeters. Furthermore it will be noted, in this same connection, that the effect of anesthesia induced continuously for a period of four and one-half hours was to cause an immediate and pronounced diuresis which increased the output of urine for the day to five hundred and twenty-three cubic centimeters, an increase of one hundred and four cubic centimeters or 24.8 per cent. This was the most pronounced diuresis observed at any time in any of our experiments. In common with the data as tabulated for Experiments V. and VI. (see Tables VII. and VIII.), the urine volume for the day following the anesthesia was sub-normal. In this instance the decrease below the normal was fifty-eight cubic centimeters or fourteen per cent. However, this sub-normality was simply temporary and was followed by three days during each of which the daily excretion was above normal. The volume for the entire period of seven days after the administration of the ether was four hundred and thirty-two cubic centimeters, an average daily increase of thirteen cubic centimeters or 3.1 per cent.

At the time the dog was placed under the influence of ether the body weight of the animal was 9.51 kg. The effect of the four and one-half hours of anesthesia was marked by an immediate loss of .22 kg. or 2.3 per cent in body weight. Correcting for the loss of .02 kg. per day noted during the preliminary period the actual loss due to the influence of narcosis was .20 kg. or 2.1 per cent. This large loss was followed by a period of four days during each of which the weight was increased somewhat above that observed on the day of anesthesia, after which the weight of the animal sank until the end of the experiment. The final weight of the dog was 9 23 kg., showing the corrected total loss in weight to have been .14 kg. or 1.4 per cent. It is interesting to observe that this loss was only slightly greater than that observed as occurring under the influence of anesthesia for a period of one hour (Experiment V.).

The first urine fraction passed after anesthesia possessed a specific gravity of 1037, and, contrary to custom, was followed by a fraction possessing a specific gravity of only 1018. The third, fourth, and fifth fractions for the day, however, possessed specific gravities of 1036, 1032, and 1039 respectively. In this instance the highest specific gravity was possessed by the fifth fraction instead of by the first fraction as was usually the rule in our experiments. The remaining fractions, with the exception of the last fraction of the fourth day, possessed specific gravities ranging from 1015 to 1019. The urines following narcosis again exhibited a tendency to assume an amphoteric reaction, but this reaction was not observed until the second fraction was passed and continued present in the third, fourth, and fifth fractions. In each of these amphoteric urines the alkaline reaction predominated.

TABLE X.

Dog No. 3. Experiment VIII.

Day.	Body Weight.	Urine. Volume.	Urine. Average Volume.	Urine. Specific Gravity.	Urine. Reaction to Litmus.	Urine. Nitrogen. Grams.	Urine. Nitrogen. Total Grams.	Remarks.
	kg.	*cc.*	*cc.*				*Per day.*	
1.....	9.30	420	... .	1018	Acid.	6.02	6.02	
2.....	9.27	397	408	1019	Acid.	6.86	6.86	
3.....	9.23	430	416	1017	Acid.	6.54	6.54	
		Ether Anesthesia, 1 Hour.						
4.....	9.10	429	503	503	1016	Acid.	5.72	7.08	* First urine after anesthesia, passed at 12.45 P.M.
		34*			1039	Acid.	0.61		† Alkaline reaction predominating.
		40			1039	Amphoteric.†	0.75		
5.....	9.15	367	400	452	1017	Acid.	5.77	6.38	
		33			1021	Acid.	0.61		
6.....	9.09	421		443	1018	Acid.	5.87	5.87	
7.....	9.08	387		429	1019	Acid.	5.68	5.68	
8.....	8.98	494		442	1019	Acid.	7.45	7.45	

9.....	8.91	376	431	1019	Acid.	5.92	5.92	
10.....	8.83	550	448	1018	Acid.	8.63	8.63	
11.....	8.75	452	449	1020	Acid.	7.63	7.63	
12.....	8.71	437	447	1018	Acid.	6.94	6.94	
13.....	8.62	480	451	1021	Acid.	8.24	8.24	
14.....	8.56	418	448	1020	Acid.	7.26	7.26	
15.....	8.50	442	447	1019	Acid.	7.71	7.71	
16.....	8.46	429	446	1020	Acid.	7.66	7.66	
17.....	8.43	421	444	1019	Acid.	7.20	7.20	

8. Discussion of Experiment VIII.: The subject of this experiment was the animal previously used in Experiment VII., the body weight having been reduced from 9.51 kg. to 9.23 kg. The nitrogen balance for the preliminary period showed an average daily gain of .16 gram. Ether narcosis was then induced for a period of one hour upon the fourth day of the experiment, the anesthesia beginning at 9.55 A.M. and ending at 10.55 A M. The beast appeared somewhat stuporous throughout the day upon which the ether was administered and was observed to be in a deep sleep a portion of the afternoon.

Urine was voided during the preliminary period at the average rate of four hundred and sixteen cubic centimeters per day, as may be seen from an examination of Table X. This daily average was increased through the influence of the one hour of anesthesia on the fourth day of the experiment to five hundred and three cubic centimeters, an increase of eighty-seven cubic centimeters or 20.9 per cent (see Table III.). The course of the daily volume of urine for days four to nine of this experiment was similar to that observed for the urine voided during the portion of Experiment VI. following anesthesia, *i.e.*, for several consecutive days the daily volumes were alternately above and below the normal. Compared according to the length of the anesthesia period we note that the increase in the urine volume upon the day of anesthesia was nearly three times as great as it was in Experiment V. where this same animal was first placed under the influence of the ether for one hour. The cumulative effect of the narcosis is also very strikingly shown by a comparison of the average daily urine volumes for Experiments V. and VIII. for that portion of each experiment which follows the day upon which anesthesia was induced. In the experiment under consideration (VIII.) the average daily volume for days four to seventeen was four hundred and forty-four cubic centimeters, an increase of twenty-eight cubic centimeters or 6.7 per cent above the normal per day, whereas when we calculate the data for Experiment V. for the analogous period we find that the urine volume was sub-normal to the extent of forty-two cubic centimeters or 9.1 per cent per day. Thus we have sharply defined opposing conditions resulting from subjecting the same animal to ether anesthesia for periods of equal length. The conditions under which the anesthesia was induced were the same in the two cases, except that in Experiment V. the animal was experiencing narcosis for the first time, whereas in Experiment VIII. he was experiencing narcosis for the same length of time as during Experiment V., but since that time he had been subjected to two other experiments covering a period of sixteen days, during which time he had been under the influence of the anesthetic for a total of six and one-half hours.

The influence of the anesthesia upon the body weight of the animal was different in this experiment than in the previous experiments upon the same animal in that the percentage loss in this case was rather less than those previously determined. On the day of anesthesia the weight of the dog was 9.23 kg., the beast having lost about .03 kg. per day throughout

the preliminary period. Making the correction for this regular loss in weight we find that the one hour of anesthesia on the fourth day of the experiment caused a loss of .10 kg. or 1.1 per cent in body weight. The next day the weight of the animal increased .05 kg., the increase probably being dependent upon the sub-normal urine output for the day. A more rapid loss of body weight than was observed in any other experiment now began and continued until the experiment closed. The final weight of the animal was 8.43 kg., indicating an actual loss of .29 kg. or 3.1 per cent during the period of fourteen days.

The first and second urine fractions passed after anesthesia possessed the customary high specific gravity (1039). The remaining samples of urine throughout the experiment possessed specific gravities ranging from 1017 to 1021, inclusive. Conditions in this experiment agree with those in Experiment VII. in showing an amphoteric reaction (alkalinity predominating) for the second fraction of urine voided after anesthesia, but differ from the conditions in Experiment VII. in that fractions three, four, and five were acid in reaction.

9. Discussion of Experiment IX.: This experiment was made upon a spotted bitch which weighed 7 kg. at the time the anesthetic was administered. Nitrogen equilibrium was established with this animal only after a preliminary feeding through a period of over two weeks, in which interval her ration was twice altered. The nitrogen balance for the six days immediately preceding the day upon which anesthesia was induced showed an average daily gain of .10 gram. At 12.15 P.M. upon the fifth day of the experiment the dog was placed under the influence of ether, the narcosis being continued for one hour. The individuality of the animal was again clearly emphasized when she proved to be the most difficult of any of our subjects to anesthetize. She also salivated far more copiously than the other dogs experimented upon.

The average daily output of urine during the preliminary period was three hundred and eighty-five cubic centimeters. There was a more pronounced diuresis in this experiment than in any of those previously described. Take for instance the day upon which the anesthetic was administered. During the day four hundred and seventy-nine cubic centimeters of urine was voided, this volume being an increase of ninety-four cubic centimeters or 24 4 per cent above normal. The urine volume continued quite uniformly high throughout the remainder of the experiment, the average daily volume for the entire period being four hundred and fifty-six cubic centimeters. This represents an average daily increase of seventy-one cubic centimeters or 18.4 per cent.

As a result of our inability to so regulate the diet of the animal as to bring her into a condition of nitrogen equilibrium in a reasonable length of time, the body weight of the animal underwent very rapid and pronounced alterations during the period of feeding preceding the preliminary period. Evidence of such variations may be observed in the data for the early days of the preliminary period as given in Table XI.

TABLE XI.

Dog No. 5. Experiment IX.

Day.	Body Weight.	Urine. Volume.	Urine. Average Volume.	Urine. Specific Gravity.	Urine. Reaction to Litmus.	Urine. Nitrogen. Grams.	Urine. Nitrogen. Total Grams.	Remarks.
	kg.	*cc.*	*cc.*				*Per day.*	
1.....	7.24	360	.....	1020	Acid.	5.86	5.86	
2.....	7.18	342	351	1019	Acid.	5.81	5.81	
3.....	7.11	370	357	1019	Acid.	5.50	5.50	
4.....	7.07	379	363	1018	Acid.	5.39	5.39	
5.....	7.03	418	374	1018	Acid.	5.97	5.97	
6.....	7.00	441	385	1019	Acid.	5.69	5.69	
				Ether Anesthesia, 1 Hour.				
7....	6.76	409	479	479	1017	Acid.	5.43	6.49	* First urine after anesthesia, passed at 4.50 P.M.
		70*			1024	Amphoteric.†	1.06		† Alkaline reaction predominating.
8....	6.89	11	420	449	1040	Amphoteric.‡	0.33	5.94	‡ Alkaline reaction predominating.
		385			1031	Acid.	4.73		
		24			1020	Acid.	0.88		
9.....	6.86	448		449	1017	Acid.	6.57	6.57	

10.....	6.71	469	454	1019	Acid.	5.96	5.96	
11.....	6.70	463	456	1018	Acid.	6.01	6.01	
12.....	6.70	502	464	1019	Acid.	6.16	6.16	
13.....	6.60	401	455	1021	Acid.	5.93	5.93	
14.....	6.52	466	456	1020	Acid.	5.87	5.87	
15.....	6.48	457	456	1020	Acid.	5.79	5.79	
16.....	6.44	459	456	1019	Acid.	5.66	5.66	

However, at the time the animal was placed under ether she weighed 7 kg. and was losing only about .03 kg. per day. The one-hour period of narcosis caused a decrease in weight to 6.76 kg. upon the day of the administration of the anesthetic This represented a loss for the day amounting to .24 kg. and correcting for the daily loss observed during the final days of the preliminary period it was found that the actual loss in body weight for the day of anesthesia was .21 kg. or three per cent. Following this initial loss there was a surprisingly large gain (.13 kg.) upon the second day after anesthesia. From this point until the close of the experiment, however, the body weight gradually fell, the final weight being 6.44 kg., thus showing this dog to have undergone an actual loss in body weight aggregating 3.7 per cent.

The urine fractions possessing the highest specific gravity were those first voided after anesthesia, the second fraction having the second highest specific gravity observed during the entire series of experiments. The specific gravity of this fraction was 1040, while those fractions voided immediately before and after this fraction possessed the somewhat lower specific gravities of 1024 and 1031 respectively. The other specific gravities of the experiment, with the exception of that for the urine of the ninth day, ranged from 1018 to 1021.

The first and second fractions of urine passed after anesthesia were amphoteric in reaction, alkalinity predominating; all other urines were acid in reaction.

IV. General discussion of the results of the nine experiments. — 1. Diuretic influence of the ether: In Table III. will be found summarized the data from the whole series of experiments regarding the influence of the ether anesthesia upon the average daily urine volume. In that table are expressed for each experiment the initial effect of the ether, *i.e.*, the influence exerted during the twenty-four to forty-eight hours immediately following the anesthesia, and the ultimate effect, *i.e.*, the influence exerted for the entire period from the time of anesthesia until the experiment closed. In addition to this we have expressed the absolute increase or decrease in the volume of urine excreted for the entire experimental period following anesthesia above that noted during the preliminary period. In Experiment I. it will be noted that the initial influence of ether anesthesia for a period of one hour was to cause an average daily increase of fifty-five cubic centimeters or 22.6 per cent in the volume of urine for a period of two days. From this

point the diuretic effect was considerably lessened, but remained persistent until the end of the experiment, the average daily increase for the entire period after anesthesia being twenty-six cubic centimeters or 10.7 per cent, and representing an absolute increase of one hundred and fifty-six cubic centimeters of urine for the period of six days. In Experiment II., although the subject was the same animal as was used in Experiment I. and anesthesia was induced twice as long (two hours) as in the first experiment, the initial influence of the ether as measured by the average urine volume for the two days subsequent to the anesthetization was considerably less than after the one hour of anesthesia. The actual average daily increase was forty-two cubic centimeters or 17.7 per cent, which was thirteen cubic centimeters or 4.9 per cent less than the increase noted in Experiment I. If we consider the influence which the anesthesia exerted throughout the entire experimental period after the animal was placed under ether, however, it is observed that the ultimate average daily increase in the volume of urine was forty-nine cubic centimeters or 20.7 per cent, and that the absolute increase in the urine output for the seven days was three hundred and forty-three cubic centimeters. It appears, therefore, with this animal that the immediate diuretic effect of one hour of anesthesia was more pronounced than a period of anesthesia which was one hundred per cent longer but which was induced six days subsequently. On the other hand, if we compare the ultimate diuretic influence which the anesthesia exerted it is observed that the diuresis was persistent in each case but that the diuresis following the two hours of anesthesia was more pronounced in the final days of the experiment than in the period of forty-eight hours immediately subsequent to the induction of the narcosis. Therefore, after the initial effect of anesthesia for one hour the diuresis was decreasing but persistent, whereas in the case of two hours anesthesia there was an increasing diuresis. The parallelism existing between the course of the nitrogen excretion and the urine volume in Experiments I. and II. was quite regular, in each instance the initial average daily increase being greater after

one-hour anesthesia, whereas the ultimate average daily increase was greater after anesthesia for a period of two hours.

The data from Experiment III. are not strictly comparable with those for Experiments I. and II., inasmuch as in Experiment III. the dog was placed under ether on each of three successive days no attempt being made to secure a condition of nitrogen equilibrium between the anesthesia periods. The influence of the one hour of anesthesia in Experiment III. is comparable with the influence of the one hour of anesthesia as noted in Experiment I., however, since the animal was in nitrogen equilibrium in each case. It is interesting to observe the similarity in the initial effect as registered in each instance; the influence being calculated for a single day in Experiment III. Comparing these two experiments from this standpoint we observe that the initial influence of one hour of anesthesia in Experiment I. was an average daily increase of fifty-five cubic centimeters or 22.6 per cent in the urine volume, whereas the initial average daily increase in Experiment III. was fifty-six cubic centimeters or 20.1 per cent, a variation of only one cubic centimeter. Considering the initial effect of the three anesthesia periods (six hours) as that observed on the three days of anesthesia, it is found that the initial average daily increase in the volume of urine was forty-three cubic centimeters or 15.4 per cent. Inasmuch as there was a pronounced, persistent, increasing diuresis of 20.7 per cent after the two hours of anesthesia in Experiment II., we might perhaps expect a more pronounced diuresis to follow a six-hour anesthesia period. Such a deduction is not substantiated by the data, however, since the six hours of anesthesia of Experiment III. registered an ultimate average daily increase in the urine volume of twenty-five cubic centimeters or 8.9 per cent as compared with an average daily increase of forty-nine cubic centimeters or 20.7 per cent after the two hours anesthesia. The ultimate average daily increase in the urine volume after the six hours anesthesia was even slightly less (one cubic centimeter) than that following the one hour of

anesthesia in Experiment I. By a comparison of the data from Experiments I., II., and III., in which the same dog was used as subject, we might infer that the first time an animal is subjected to ether anesthesia the immediate diuretic effect of the anesthetic is more pronounced than that which follows subsequent anesthesia even when the anesthesia is induced from two to six times as long as at the first narcosis. Further, our datafrom these three experiments indicate that a second anesthetization of an animal brought to a condition of nitrogen equilibrium after the first anesthesia produces a much less pronounced diuresis during the period immediately following anesthesia, but that the diuretic effect increases from this point causing the diuresis to be much more pronounced from the third to the seventh day after the anesthesia than it was in the first forty-eight hours after the animal was anesthetized. With this animal the maximum diuretic effect was probably secured after the second anesthesia, inasmuch as a subsequent anesthesia for six hours, although productive of a persistent diuresis, did not succeed in bringing about such a pronounced ultimate diuretic effect as that noted after the second period of anesthesia. The contention that the maximum diuresis was produced by the second anesthesia is borne out by the fact that the diuresis yielded an increase in the urine volume aggregating three hundred and forty-three cubic centimeters during a seven-day period after the second anesthesia, and an increase of three hundred and fifty cubic centimeters during a period twice as long (fourteen days) after the third anesthesia.

In Experiment IV. the influence of one-half hour of anesthesia upon Dog No. 2 was noted. The same tendency toward diuresis was observed as has already been noted in the experiments previously discussed. In this instance, as might be expected from the length of time the animal was under the influence of the anesthetic, the initial average daily increase in the urine volume was only seventeen cubic centimeters or 5.7 per cent, an increase less than one-third as great as that observed after the one hour of anesthesia in the case of Dog No. 1. The diuresis was more uniform

throughout the experiment in this case, however, than in any other experiment during the investigation as is shown by the fact that the ultimate average daily increase in the volume of urine was sixteen cubic centimeters or 5.4 per cent, an average daily increase only one cubic centimeter less than that noted during the first forty-eight hours following anesthesia. A total of eighty cubic centimeters above the normal urine volume was excreted in a period of five days.

In Experiment V., Dog No. 3 was subjected to his first anesthesia which continued for one hour. The initial effect of the administration of the anesthetic was confined to the day of anesthesia, the urine volumes for the next two days being decidedly sub-normal. The initial diuresis consisted of an increase of thirty-one cubic centimeters or 6.8 per cent in the urine volume for the day of anesthesia. This was the minimum initial increase in the urine volume following a one-hour period of anesthesia. The ultimate effect of the anesthesia was different in this experiment from that observed at any other time during the investigation. Starting out with the initial increase noted above, the average daily volume of urine became sub-normal on the following day and continued to decrease further from the normal until the last day of the experiment. The ultimate average daily decrease in the urine volume for the whole period of the experiment after the administration of the anesthetic was forty-two cubic centimeters or 9.1 per cent, while the total volume of urine excreted during the six-day period was two hundred and fifty-two cubic centimeters less than normal. This final result is directly opposed to the results obtained in our other experiments. It is especially interesting to compare this result with the ultimate effect of the one hour of anesthesia in Experiment I. In each instance all the factors which were open to control were made uniform, *i.e.*, both dogs were at nitrogen equilibrium at the time of anesthesia, were fed a uniform diet and subjected to anesthesia for the same length of time. Under these conditions the ultimate effect on Dog No. 1 was an ultimate average daily increase

in the volume of urine amounting to twenty-six cubic centimeters or 10.7 per cent, whereas the ultimate effect on Dog No. 3 was an average daily decrease of forty-two cubic centimeters or 9.1 per cent. These data lend color to the belief that the influence of ether anesthesia is more or less influenced by the individuality of the organism, and that the subjection of two animals to ether anesthesia for similar periods may result in one case in a persistent diuresis and in the other in an average daily volume of urine which is subnormal.

Dog No. 3 was again subjected to the influence of ether in Experiment VI., on this occasion the length of anesthesia being two hours. As was the case after one hour of anesthesia, as set forth in Experiment V., the initial influence of the ether was confined to the day of anesthesia, the volume of urine being increased fifty-three cubic centimeters or 12.9 per cent for the day. The course of the diuresis was different in this experiment from that observed in Experiment V., inasmuch as after two hours anesthesia the diuresis persisted until the end of the experiment, showing an ultimate average daily increase of sixteen cubic centimeters or 3.9 per cent in the output of urine. As we have already seen, the ultimate effect of one hour of anesthesia with this same animal was to cause an average daily decrease of forty-two cubic centimeters or 9.1 per cent in the volume of urine. The absolute increase in the volume of urine for the five days after anesthesia was the same in this instance (eighty cubic centimeters) as after one-half-hour anesthesia (Experiment IV.). In Experiment VI. the course of the nitrogen excretion was similar to that of the urine volume since the initial average daily excretion of nitrogen was considerably higher after the two hours of anesthesia (.85 gram or 13.1 per cent) than after the one-hour period of anesthesia (.56 gram or 8.5 per cent) in Experiment V., and further a parallelism is noted in the fact that the ultimate effect of the one hour of anesthesia was an average daily decrease in both the nitrogen and urine output, whereas the ultimate effect of the two hours of anesthesia was an average daily increase in

the nitrogen output. In the case of both the nitrogen output and the urine volume we further observe that the decrease after one hour of anesthesia was greater than the increase after the period of anesthesia extending over two hours.

The influence of four and one-half hours of anesthesia on Dog No. 3 is shown in Experiment VII. As was the case when this animal was placed under ether for periods of one and two hours (Experiments V. and VI.) the initial influence of the anesthetic was limited to the day of anesthesia, the urine volume for the day following being sub-normal. An increase of one hundred and four cubic centimeters or 24.8 per cent was noted on the day of anesthesia, this being the maximum initial diuresis observed during the course of the investigation. Although the immediate effect of the ether upon the urine output was more pronounced after four and one-half hours anesthesia than after anesthesia for periods of one and two hours with this same animal, yet the diuretic effect was somewhat less in the closing period of the experiment than was observed after two hours anesthesia, the ultimate average daily increase in the urine volume being thirteen cubic centimeters or 3.1 per cent after four and one-half hours anesthesia and sixteen cubic centimeters or 3.9 per cent after two hours of anesthesia. The uniformity with which the initial influence of anesthesia increases with the length of time during which the animal was under the influence of the anesthetic is very clearly shown by a comparison of the data from Experiments V., VI., and VII. Here we have the same animal (Dog No. 3) subjected to periods of anesthesia one, two, and four and one-half hours in length and secure, as the initial effect upon the urine volume, increases of thirty-one cubic centimeters or 6.8 per cent, fifty-three cubic centimeters or 12.9 per cent, and one hundred and four cubic centimeters or 24.8 per cent respectively. The initial diuresis was therefore roughly proportional to the length of the anesthesia period.

The most pronounced variation in the effect of the first anesthetization of an animal as compared with the effect of

anesthesia for a similar period subsequently is noted in connection with the tests on Dog No. 3. In Experiment V. this animal was subjected to one-hour anesthesia as a result of which an initial diuresis was observed on the day of anesthesia which increased the urine volume for the day thirty-one cubic centimeters or 6.8 per cent, whereas the ultimate effect of the anesthesia was an average daily decrease of forty-two cubic centimeters or 9.1 per cent in the output of urine for the final period of the experiment. Later in Experiment VIII., after this animal had meanwhile been subjected to anesthesia for periods of two and four and one-half hours, we observe the effect of one-hour anesthesia to be an initial average daily increase in the urine volume of eighty-seven cubic centimeters or 20.9 per cent upon the day of anesthesia and an ultimate average daily increase of twenty-eight cubic centimeters or 6.7 per cent in the output of urine for the entire final period. Now in each instance where the anesthesia was induced for one hour the animal was at nitrogen equilibrium, and the main point in which the conditions differed under which the anesthetic was administered on the two occasions was the fact that in Experiment V. the animal experienced anesthesia for the first time, whereas in Experiment VIII. anesthesia was induced for the fourth time on this same animal. This increase of approximately three hundred per cent in the initial influence of one-hour anesthesia between the first and fourth administrations of the ether is very noteworthy.

In Experiment IX., Dog No. 5 was subjected to a single one-hour period of anesthesia. The effect of the ether was much more pronounced with this subject than was noted in the case of the others, as is shown by an initial diuresis sufficient to increase the urine volume ninety-four cubic centimeters or 24.4 per cent on the day of anesthesia, and further by a very pronounced persistent diuresis which caused the ultimate average daily output of urine for the final period of the experiment to be increased seventy-one cubic centimeters or 18.4 per cent above normal. This diuretic effect was sufficient to cause an excess output of seven hundred

and ten cubic centimeters of urine in the course of ten days. A further indication that the extent of the initial diuresis following ether anesthesia is dependent upon the individuality of the subject is shown by a comparison of the initial increase noted in each of Experiments I., V., and IX. In each of these cases anesthesia was induced for a period of one hour, but each time upon a different subject, the initial average daily increase in the volume of urine for the three experiments named being fifty-five cubic centimeters or 22.6 per cent, thirty-one cubic centimeters or 6.8 per cent, and ninety-four cubic centimeters or 24.4 per cent.

An examination of the tabulated data for the different experiments will show that there were intervals of varying lengths between the termination of the anesthetic state and the voiding of the first fraction of urine. We have studied this temporary suppression of the urine flow under ether narcosis by means of experiments in which cannulas were inserted into the ureters of dogs and the rate of urine flow noted under anesthesia periods of varying lengths. This feature will therefore be fully discussed in a future paper.

2. Influence of the anesthesia upon the body weight of the animal: The data from the series of experiments indicate that anesthesia was followed in each instance by a loss of body weight. The extent of the loss in weight was, for the most part, rather independent of the length of anesthesia, although there are certain indications of a uniformity in the loss in body weight under like conditions. For instance, the losses in weight in four out of the five instances where the length of anesthesia was one hour were 2.8 per cent, 2.8 per cent, 3.1 per cent, and 3.7 per cent respectively, and furthermore the total loss of weight in Experiment III., where the length of anesthesia aggregated six hours, was 6.5 per cent at the end of the third day and 10.2 per cent for the whole period of fourteen days. This last observation indicates that the loss in body weight varied with the length of the anesthesia period. In nearly every instance the loss in body weight upon the day of anesthesia was greater than the ultimate loss in body weight calculated for the whole

period after anesthesia. In other words, in many cases the administration of the anesthetic caused a considerable loss of body weight upon the day of anesthesia, and this loss was apparently further increased in the succeeding days. However, when the data were corrected for the normal daily loss as observed during the preliminary period, it was found in some instances that the total loss in body weight was less than the initial loss, thus indicating that the body had recovered during the final days of the experiment a portion of the body weight lost upon the day the anesthetic was administered.

3. Specific gravity of the urine as influenced by ether narcosis: In every instance the administration of ether caused a pronounced rise in the specific gravity of the urine. Data on this point was secured by determining the specific gravity of the fractions of urine first voided after anesthesia. The specific gravity of the urine during the preliminary period was generally 1015–1019, whereas under the influence of the ether this specific gravity was generally increased to 1026–1042 in the fractions of urine first voided. This fraction was ordinarily not voided for several hours after the administration of the anesthetic.

4. Reaction of the urine before and after the administration of ether: The urine was acid in reaction throughout the preliminary period of each experiment. Under the influence of anesthesia this normal acid reaction was changed to amphoteric in seven of the nine experiments. This change was but transitory since the amphoteric reaction was never obtained in more than four fractions of urine and was never obtained longer than twenty-four hours after anesthesia. In the seven experiments where the anesthesia was productive of an amphoteric reaction this reaction was present in four instances in the urine fraction first voided after anesthesia. Of the remaining three cases the amphoteric reaction was noted in the second fraction of urine on two occasions and in the third fraction of the remaining experiment. The observation of an amphoteric reaction in the urines of Dog. No. 1 for the fifteenth and

sixteenth days of Experiment III. apparently has no direct relation to the anesthesia. The change from an acid to an alkaline reaction under the influence of ether anesthesia as frequently observed by Baldwin [16] in observations made upon clinical cases was not noted in the case of our dogs, although in practically every instance of an amphoteric reaction the alkalinity was the predominant feature of the reaction. The strengthening of the acid reaction of the urine following ether anesthesia which this same investigator observed in the clinical cases mentioned was not noted in our experiments.

V. CONCLUSIONS.

1. Ether narcosis induced for periods varying in length from thirty minutes to four and one-half hours was followed in every instance by an initial diuresis, the extent of the diuresis being proportional, in some instances, to the length of the anesthesia period. This point is well illustrated by the initial diuresis of 5.7 per cent, 6.8 per cent, 12.9 per cent, and 24.8 per cent which followed ether anesthesia periods of one-half, one, two, and four and one-half hours respectively.

2. The diuretic effect of the ether was persistent in every experiment except one, the ultimate average daily percentage increase in the urine volume ranging from 3.1 per cent to 20.7 per cent.

3. The cumulative diuretic effect of ether anesthesia was clearly demonstrated by an ultimate average daily percentage decrease of 9.1 per cent following the first administration of ether to a subject as contrasted with an ultimate average daily increase of 6.7 per cent which followed the fourth administration of the anesthetic to the same animal for a period of the same length.

4. Ether anesthesia invariably caused the animal to lose weight upon the day of the narcosis. Initial losses of this character ranging from 1.1 per cent to 3 per cent were observed. Anesthesia induced upon each of three successive days was productive of a loss of body weight which aggregated 6.5 per cent upon the day of the final anesthetization.

5. The fractions of urine first voided after ether anesthesia possessed specific gravities ranging from 1024 to 1042, whereas the specific gravity of the urine under normal conditions generally varied from 1015 to 1019.

6. Ether narcosis was generally followed by the appearance of an amphoteric reaction in the fraction of urine first voided after anesthesia, but frequently such reaction could not be demonstrated earlier than the passage of the second or third fraction after narcosis. In two experiments, upon different subjects, the urine was uniformly acid in reaction both before and after the administration of the anesthetic.

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